REQUEST FOR ADDITIONAL INFORMATION
Volume 2 – Preclosure
Chapter 2.1.1.4, Set 2 – Identification of Event Sequences
(RAI #1 - #13)

The following questions pertain to DOE's evaluation of passive structure, system, and component reliability described in SAR Section 1.7.2.3. This information is needed to assess whether or not DOE has demonstrated compliance with 10 CFR 63.112(b), which requires DOE to describe and discuss analyses for identification and categorization of potential event sequences resulting from surface and subsurface operations and demonstration of compliance with the requirements of §63.111(a) and (b). In addition to the SAR, these questions also refer to other references in the LA and on the docket. Unless otherwise specified, references cited in the following RAIs are from SAR Section 1.2.2.

References:

BSC 2008a, *Seismic and Structural Container Analyses for the PCSA*, 000-PSA-MGR0-02100-000-00A. Las Vegas, Nevada: Bechtel SAIC Company, LLC.

BSC 2008b, *Canister Receipt and Closure Facility Reliability and Event Sequence Categorization Analysis*, 060–PSA–CR00–00200-000–00A. Las Vegas, Nevada: Bechtel SAIC Company, LLC

Kelker, J.W., Jr. 1986. *SRL Canister Impact Tests*. DP-1716. Aiken, South Carolina: Savannah River Laboratory

RAI #1
Provide the following reference

BSC 2008a, *Seismic and Structural Container Analyses for the PCSA*, 000-PSA-MGR0-02100-000-00A. Las Vegas, Nevada: Bechtel SAIC Company, LLC.

This doc is needed to verify the event sequences associated with structural and thermal challenges on canisters.

RAI #2
Provide technical bases for weighting factors used to develop the weldment fragility curves for canisters (SAR Section 1.7, BSC 2008a Section 6.3.7.4), and provide the weldment fragility curves.

In Section 6.3.7.4 of BSC, 2008a, the applicant has discussed the development of the weldment fragility curves for representative canisters. However, the applicant has not provided the weldment fragility curves, nor the technical bases for the weighting factors used to develop the curves.

RAI #3

Provide technical basis for the assumption that Transportation Aging and Disposal (TAD) canisters and Dual Purpose Canisters will drop vertically, guided by the rails (SAR Section 1.7.2.3.1), and not off-vertical, during a transfer operation by the canister transfer machine and a seismic event.

DOE evaluation of TAD and DPC canisters for at a 23 feet 4-degree off-vertical drop in Table D 1.2-3 (BSC, 2008b) shows a significantly high probability of breach compared to 32.5 or 40 feet vertical drop. As indicated in SAR section 1.7.2.3.1, DOE relies on the guide sleeves to ensure a flat-bottom drop of canisters. The applicant, however, has not provided technical basis for not considering tolerances in placement of the guide rails, and description, design, and performance of the guide rails to demonstrate that the guide rails will perform its intended safety function during (a) operational event sequences and (b) seismic event sequences associated with transfer of canisters by the canister transfer machine.

RAI #4

Clarify whether or not thermal and strain-rate effects on the strength of canister steel material are considered in development of probability of failures for canister steel, listed in Table 6.3.7.3-1 (BSC. 2008a).

In Table 6.3.7.3-1 (BSC 2008a), the applicant has provided information on probability of failures versus true strain for canister steel. However, it is not clear whether or not the applicant has considered the effects of both temperature and strain-rate in developing the fragility curves for the canister steel.

RAI #5

Provide the equivalent plastic strain distribution located in the cylinder wall weldment zone for the Dual Purpose Canister subjected to the 32.5-ft and 40-ft drop (in a vertical orientation) impact conditions (D.1C 1a and D.1C 1b, respectively), Figures 6.3.3.1-1 and 6.3.3.1-3 (BSC, 2008a).

Figures 6.3.3.1-1 and 6.3.3.1-3 (BSC, 2008a), do not clearly show whether the maximum effective plastic strain occurs in the shell or in the weldment zone. This information is required to verify whether shell or weldment fragility curves should be used for determining failure probability of a canister.

RAI #6

Explain the applicability of the shell wall and bottom-plate thickness sensitivity study presented in Table 6.3.3.6-1 (BSC, 2008a) to a TAD canister which has the design features given in Table 4.3.3-2 (BSC, 2008a).

Table 6.3.3.6-1 (BSC, 2008a) considers the orientation of 4 degrees off-vertical for dual purpose canister designs having different shell and bottom thicknesses. For case name S3-L3, this design has a maximum effective plastic strain of 18.08% and if the triaxiality factor is used Table 6.3.7.6-3 shows significant failure probabilities, i.e. on the order of 10^{-2} to 10^{-1}. Therefore, staff requests that further explanation of which case in Table 6.3.3.6-1 most closely models that of a TAD canister.

RAI #7

Provide information on the initial canister internal pressures used in determining limit strength values of steel at various temperatures, and developing probability of failure values (Section D2.1.4.5.3.3 of BSC2008b).

RAI #8

Provide technical basis for choosing a Weibull distribution for internal canister pressure distribution, and associated parameters (scale factor, shape factor, the minimum value) (Section D2.1.4.5.3.3 of BSC 2008b).

RAI #9

Provide technical basis for choosing a normal distribution from series of runs for the heat-up rate that accounts for uncertainty in the rate of temperature increase in canisters while calculating pressure differentials (Section D2.1.4.5.3.3 of BSC 2008b). This information is to verify canister reliability as calculated is not underestimated.

RAI #10

Provide technical basis for selection of a 950 K temperature as a canister failure threshold temperature (Section D2.1.5.2 of BSC 2008b) for all canisters shown in Table D2.1-8. For example, selection of 950 K threshold appears to produce 32 observations in thin-walled canisters in which failure of canister is predicted to occur. These observations can be seen in Figure D.2.1.-6, however, the corresponding observations in the response curve Figure D 2.1-4 do not seem to correlate with 950 K threshold. Relevance of Figure D 2.1-4 in the calculation is not clear. Clarification of (a) selection of 950 K threshold and (b) determination of “Total Failures” are necessary to support the failure probability found in Table D2.1-8.

RAI #11

Provide following clarifications with respect to probability of failure of stainless steel HLW canisters:

(a) Explain the reference to maximum effective plastic strain values in the Design Criteria of SAR Table 1.5.1-17 and the High Level Waste (HLW) canister capacity curve. As discussed in Section D1.3 (BSC 2008b) HLW canister probability of breach was estimated based on HLW canister drop test data and Bayesian approach.

(b) Provide basis for using probability value of 3×10^{-2} for HLW canister breach (SAR Table 1.5.1-17) in the event sequence analyses involving HLW waste canister drop. Probability of HLW canister discussed in Section D1.3 (BSC2008b) shows an estimate of 6.7×10^{-2} (Table 6.3-2, BSC 2008b) determined using HLW canister drop test data and Bayesian analysis.

(c) Provide technical basis for selecting the 13 number of drops from 30-ft drop tests, described in Reference D4.1.17 of BSC 2008b and used to calculate the failure probability of HLW canister (Section D1.3, BSC 2008b).

RAI #12

Justify the distribution of fire duration used in the fragility analysis, as given in Table D2.1–1 (BSC 2008b), and compare the distribution with the historical fire durations implied by data in Table F.II–2 of BSC (2008b).

Table D2.1–1 (BSC 2008b) shows that only 1.1 percent of fires would last longer than 2 hours. Based on the historical data in Table F.II–2 for extent of fire damage in facilities handling radioactive material, and nuclear energy plants, it appears that 16 percent of fires would have sufficient duration and intensity to propagate through at least one (and perhaps multiple) fire resistance-rated barrier(s) within the facility. As these fire barriers are typically rated to resist substantial fires for between 1 and 4 hours, up to 16 percent of the fires could last longer than 2 hours, in contrast to 1.1 percent shown in Table D2.1-1.

RAI #13

Provide technical justification of the assumed mean fire temperature 1,072 K [799 ºC] and standard deviation of 172 K, assuming a normal distribution (BSC, 2008b, Section D2.1.2 Uncertainty in Fire Temperature).